

DISCUSSION OF THE AMENDMENT

Claims 1 and 15 have been amended by adding step numbers before each recited step, and adding antecedent bases where appropriate. In addition, the “reduced content . . .” preamble has been deleted, and the recital of a one-stage reaction and liquid-liquid distribution has been moved to end of the respective claim.

Claims 13 and 21 have been amended by deleting that the resin solution has “a moderate flowability” and reciting when the recited step occurs.

Claims 14 and 22 have been amended to recite that the step is carried out after step (12), as supported in the specification at, for example, page 34, beginning on the 7<sup>th</sup> line from the bottom, regarding Example 4, corresponding to the description: “The organic phase was again diluted with 1000g of methyl ethyl ketone. “

Claims 4-14 and 18-22 have been amended to remove improper multiple dependency.

The remaining amendments delete superfluous language.

No new matter is believed to have been added by the above amendment. Claims 1-22 remain pending in the application.

REMARKS

Due to the length of the specification herein, Applicants will cite to the paragraph number of the published patent application (PG Pub) of the present application, i.e., US 2007/0225462, when discussing the application description, rather than to page and line of the specification as filed.

The rejection of Claims 1-3 and 15-17 under 35 U.S.C. § 103(a) as unpatentable over US 2,385,370 (Norton)<sup>1</sup> in view of JP 2003-277308 (Honda), US 3,410,818 (Yurcick et al) and US 3,814,713 (Honda et al), is respectfully traversed.

As recited in Claim 1, an embodiment of the present invention is a process for producing a resorcinol-formalin resin containing no inorganic salts and having a reduced content of resorcinol monomer and a reduced content of resorcinol-formalin resin of resorcinol pentanuclear or higher nuclear bodies, all steps including a one-stage reaction and liquid-liquid distribution being conducted in the same reactor, which comprises adding, to a water solvent, resorcinol (A) in an amount of 20 to 150 parts by weight relative to 100 parts by weight of water, an inorganic salt (B) in an amount of 20 to 80 parts by weight relative to 100 parts by weight of water, and an organic solvent (C) having a solubility parameter of 7.0 to 12.5 and capable of dissolving the resorcinol-formalin resin in an amount of 10 to 200 parts by weight relative to 100 parts by weight of resorcinol (A); stirring the mixture at a liquid temperature not higher than the boiling point of the organic solvent (C) to give a two-phase system containing no remaining solid matter; adding a catalytic amount of an organic acid or inorganic acid (D); adding 1 to 40% formalin (E) dropwise in a molar ratio of formaldehyde/resorcinol of 0.3 to 0.8 under stirring over a period of 1 to 300 minutes while maintaining the reaction system at 0 to 60°C; stirring the mixture for further 10 to 60 minutes after the completion of the dropwise addition to cause a liquid-liquid heterogeneous reaction

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<sup>1</sup> Norton has not been made of record herein. The Examiner is respectfully requested to cite Norton on a Form PTO-892 in the next Office communication.

to proceed; allowing the reaction system to stand while maintaining it at the temperature of the reaction to separate it into two layers; removing the aqueous layer; adding an organic solvent (C) in an amount of 1 to 5 equivalents to the amount of the reaction product to the reaction product layer which is an organic solvent layer to effect dilution; adding water to the reaction product layer in an amount which is half of the amount of the organic solvent; stirring the reaction system while maintaining its temperature to be not higher than the boiling point; separating it into two layers after allowing it to stand; and then removing the aqueous layer to obtain a resorcinol-formalin resin.

Another embodiment of the present invention, as recited in Claim 15, is, in effect, the product made by the process of Claim 1.

As described in the specification under Background Art, beginning at paragraph [0002], resorcinol-formalin resins are known in the art, but flowability has been problematical, as well as the suggested solutions thereof. An object of the present invention, as described in the specification at paragraph [0006], is to provide a process for producing a resorcinol-formalin resin containing no salts and having a moderate flowability when transformed into an aqueous solution, which is capable of reducing both the content of resorcinol monomer and the content of resorcinol-formalin resin of resorcinol pentanuclear or higher nuclear bodies in a one-stage reaction. Applicants have been able to attain this objective by adopting a liquid-liquid heterogeneous reaction using a specific range of organic solvents, i.e., organic solvents having a solubility parameter within a particular range, as described in the specification at paragraph [0007].

The specification herein contains comparative data demonstrating the significance of various parameters of the presently-claimed process and product obtained thereby. Examples 1-11 are according to the presently-claimed invention. Comparative Examples 1 and 2 are

not. The results for Comparative Examples 1 and 2 were deficient, as described in the specification at paragraphs [0103] and [0104], respectively.

Norton discloses a process for producing a resin produced by reacting a dihydroxy benzene such as resorcinol with an aldehyde, such as formaldehyde, comprising dissolving resorcinol in a diluting medium so that upon reaction with formaldehyde, a permanently fusible resin is formed containing none or substantially very little of a heat reactive type of resin, i.e., a resin which will set by itself at high temperatures, wherein the liquid diluting medium is adapted to assist in preventing premature setting-up of the reaction product and also serves to slow down the reaction and assists in preventing production of undesirable by-products (page 1, left column, lines 22-36), wherein water is disclosed as the preferable diluting medium, although an organic diluting medium may also be used (page 1, left column, lines 37-48), the reaction being carried out in a neutral or acid catalyst (page 1, left column, lines 49-54). Norton discloses that one method of introducing the formaldehyde is to add it drop by drop while continuously stirring the reaction mixture (page 1, right column, lines 30-33). After the reaction is completed, the diluting medium is evaporated under vacuum and the temperature raised while the reaction mass is still under vacuum in order that any remaining traces of volatile non-reactive ingredients are driven off, after which the product is poured out and cooled to a brittle resin (page 1, right column, lines 38-53).

Thus, Norton does not disclose the combination of water and a particular organic solvent as his diluting medium, does not allow his reaction system to stand to separate it into two layers, and thus does not remove the aqueous layer, does not add an organic solvent to an organic solvent layer, does not add water to the reaction product layer, does not stir the reaction system while maintaining its temperature to be not higher than the boiling point, does not separate it into two layers after allowing it to stand, and then does not remove the aqueous layer to obtain a resorcinol-formalin resin.

Recognizing that Norton does not disclose the addition of an inorganic salt in his reaction system, the Examiner relies on Honda.

Honda discloses the use of a molecular weight modifier [0009], which may be a particular organic or inorganic salt [0013] to adjust the molecular weight of a resultant resorcinol-formaldehyde reaction product and limit the amount of unreacted resorcinol present therein, in a reaction in which formaldehyde reacts with resorcinol under water. The Examiner holds that it would have been obvious to add such a salt to Norton to control the molecular weight of Norton's resorcinol-formaldehyde product and reduce the amount of unreacted resorcinol therein.

Recognizing that Norton does not disclose the addition of an organic solvent to his reaction medium (although as discussed above, Norton discloses the use of an organic solvent in lieu of water as his diluting medium), the Examiner relies on Yurcick et al. Yurcick et al discloses that modification of a resorcinol-formaldehyde resin with a modifying agent comprising certain aromatic hydroxycarboxylic acids or amides gives a novel resinous composition which when combined with rubber latex results in tire cord adhesive systems which are superior to conventional adhesives of this type (column 1, lines 31-37). Yurcick et al discloses that their modified resinous composition may be obtained by carrying out a reaction in one or two stages (column 2, lines 28-45) in either an alkaline or acid medium (column 2, lines 46-54), and that the reaction may be carried out in aqueous medium or with the presence of additional organic solvents such as low molecular weight alcohols, ketones and esters such as methanol, acetone and ethyl acetate in order to help dissolve the various components where such is desired or necessary (column 3, lines 59-65). The Examiner holds that it would have been obvious to add the organic solvent of Yurcick et al to the reaction medium of Norton, in order to increase the solubility of the various components during the reaction.

Recognizing that Norton does not disclose diluting his product with an organic solvent, the Examiner relies on Honda et al. Honda et al discloses an adhesive composition for bonding rubber materials to any of various materials including synthetic and natural polymers, metals, silicate and ceramic materials with only a single application, which composition comprises a rubber latex, a high molecular weight resorcinol-formaldehyde resin and a low molecular weight resorcinol-formaldehyde resin, wherein the latter component contains unreacted resorcinol in an amount less than 15 wt% (Abstract). The low molecular weight resorcinol-formaldehyde (RF) resin is disclosed as “must be prepared carefully according to a particular process” (sentence bridging columns 2 and 3). This component is obtained by reacting resorcinol with formaldehyde in a mole ratio of 1 to 0.05-0.8, preferably in water and without a catalyst or in the presence of a very small amount of an acidic catalyst (column 4, lines 6-12). Honda et al discloses further that in order to synthesize the low molecular weight RF resin involving very little or no amount of resorcinol polymers higher than the pentamer inclusive, it is necessary to react resorcinol with formaldehyde while limiting the amount of the latter to less than equimole of the former (column 4, lines 34-38). After completion of the reaction, the reaction product is dissolved in a ketone, and the extract is repeatedly washed with water or extracted therewith so that unreacted resorcinol is selectively transferred to the water phase, thereby resulting in RF resin having unreacted resorcinol in an amount decreased down to a predetermined ratio, wherein methyl isobutyl ketone and diisobutyl ketone are the preferred ketones, which ketones are used in an amount of 4 to 6 times the lower molecular weight RF resin (column 5, lines 1-43). The Examiner holds that it would have been obvious to have used the solvent dilution and water extraction step of Honda et al to reduce the amount of unreacted resorcinol in Norton.

In reply to the Examiner’s findings and holding, it is not clear why one of ordinary skill in the art would combine the above prior art but even if combined, the result would not

be the presently-claimed invention. Norton discloses that after the formaldehyde is added, refluxing is continued for a suitable length of time to ensure complete reaction of all the ingredients (page 1, right column, lines 42-46). Similarly, stirring is carried out for a sufficient time for all the resorcinol to be reacted with the formaldehyde (page 2, left column, lines 44-48). Thus, unreacted resorcinol is **not** a problem in Norton and therefore, one of ordinary skill in the art would not go to Honda or Honda et al to fix a non-existent problem. Yurcick et al is irrelevant because the reaction therein is not simply that of resorcinol with formaldehyde but with these compounds as well as the required modifying agent therein. In the one stage reaction embodiment therein, all of the reactants are mixed together at one time (column 2, lines 30-34) and thus it is impossible to predict what effect the presence of the additional organic solvents with the aqueous medium therein would have when the modifying agent is not present. Nevertheless, neither Yurcick et al, nor any of the other applied prior art, distinguishes among organic solvents *per se*, unlike the presently-claimed invention which is limited to organic solvents having a solubility parameter of 7.0 to 12.5. Nor does any of the applied prior art disclose or suggest carrying out a liquid-liquid heterogeneous reaction, followed by two layer separation, followed by removing the aqueous layer, followed by adding an organic solvent having a particular solubility parameter to the organic solvent layer, followed by adding water thereto, followed by stirring or maintaining its temperature to be not higher than the boiling point, followed by separating it into two layers, followed by removing the aqueous layer to obtain a resorcinol-formalin resin.

As described at paragraph [0056] of the specification, the process for producing a resorcinol-formalin resin according to the invention is characterized by the adoption of a liquid-liquid heterogeneous reaction. The advantages derived from the adoption of the liquid-liquid heterogeneous reaction are as follows: (1) since the reaction proceeds faster in an aqueous phase and the existing ratio of resorcinol is in favor to the aqueous phase, the

amount of unreacted resorcinol can be reduced; (2) the solubility of the resorcinol polynuclear bodies (especially, tetranuclear or higher nuclear bodies wherein three-dimensional structures are present) are rapidly decreased with the progress of the reaction and hence they migrate into an organic phase; furthermore, since the reaction proceeds slower in the organic phase, the formation of resorcinol pentanuclear or higher nuclear bodies are inhibited; (3) since the reaction proceeds in both of the aqueous phase and the organic phase, the reaction time can be shortened; (4) the reaction is completed as an one-stage reaction between resorcinol and formalin and a step for removing the resorcinol polynuclear bodies after the reaction is not necessary, and (5) for the above reasons, the formation of both of unreacted resorcinol and resorcinol polynuclear bodies can be reduced, the reaction time can be shortened, and also the reaction can be completed in a one-stage reaction, so that the process is extremely advantageous in view of the cost.

The applied prior art neither discloses the present invention or its advantages, as above discussed.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The objection to Claims 4-14 and 18-22 as being improper multiply dependent claims is now moot in view of the above-discussed amendment. Accordingly, it is respectfully requested that the objection be withdrawn.



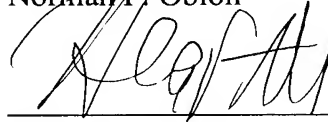
Application No. 10/574,774  
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All of the presently-pending claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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